OPAALS PROJECT

Contract n° IST-034824

WP11: Bridging Digital Ecosystems Research to Regional Development and Innovation in the Knowledge Economy

D11.6 – Knowledge Sharing Behaviour in a Digital Ecosystem (that Initiates and Fosters Autopoiesis in a Socio-Technical Ecosystem).

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Short Description: The deliverable provides theoretical framework for understanding the dialectical tension of a large, participative, innovation network in participatory mode of development. In this process it explores autopoietic, associative principles in a digital ecosystem, by offering an array of theoretical and empirical discussions of core concepts from a social science perspective.

Author: Jayanta Chatterjee (IITK) and Debashis Pattanaik (IITK)

Partners contributed: None

Made available to: All project partners and public

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Dependences:

Achievements*	We have examined a number of theories that have relevance for understanding self-organizing principles in a digital ecosystem. We have examined the relvance of autopoiesis (social), normative rule systems and cross pollination effect in knowledge sharing culture of Digital Ecosystem Community. We are able to propose a new framework, which can be considered as a preliminary framework for understanding circularity of communication and autopoieis in an emergent Digital Ecosystems theory.
Work Packages	What exactly were the contributions to other WP and what effect they have had on the work in these other WPs (max 2 pages) What exactly are the future contributions to other work packages (max 2 pages) We assume that this deliverable can have impacts on: 1. D12.10, in further elaborating the social autopoiesis principles. 2. WP11of phase 3 in the conceptualisation and operationalisation of knowledge networks, OKS and Digital Ecosystem. 3. Task 11.5, in DE design
Partners	T6, LSE
Domains	Social Science (major orientation), Biological Science (minor orientation) Computer Science (minor orientation).
Targets	Domain researchers and scientific communities on specific domains.
Publications*	Paper 1 - An expanded version of this paper has been presented at TATA Institute of Social Science on Social Network Analysis International Conference2008, Mumbai. Paper 2 - has been published in the Proceedings of the 2nd OPAALS International Conference, 2008 Tampere, Finland. Paper 3 - has been an published in the Proceedings of the IEEE-CASE 2009, Bangalore, India.
PhD Students*	None

Outstanding features*	Specify the outstanding features of the work being done (incremental change in the state of art, improving significantly the state of art, or going beyond) and if anyone outside the OPAALS Consortium has taken notice of this work. Provides an innovative blending of theoretical and empirical insights from a social science perspective towards a multidisciplinary theoretical framework for digital ecosystems. We believe that this report represents an incremental improvement in the state of the art towards an integrated theory of digital ecosystems. Some of the work presented here has been highlighted by GTZ-Knowledge System in Rural Areas in German
Disciplinary domains of authors*	Specify the names of the authors and their disciplinary affiliation(s) **Social Science**: Jayanta Chatterjee (IITK), Debashis Pattanaik (IITK)

The information marked with an asterisk (*) is provided in order to address Recommendation n. 4 from the Year 2 review report

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Abstracts

Paper - 1
Introductory Paper: Digital Ecosystem for Knowledge - The DEAL Perspective and Social Network Analysis for Impact Evaluation

Indian agriculture that engages about six hundred million people across the vast expanse of the sub continent is a large socio-technical system that has earlier shown remarkable adaptive features over last five decades. This complex adaptive system however has lately started to languish and need infusion and diffusion of knowledge driven innovation across the entire value chain. Digital Ecosystem for Agriculture and Rural Livelihood (DEAL) is step toward knowledge driven agriculture in India. In this paper we try to explore how complex activities in a Digital Ecosystem (DE) become self-organizing and self-catalyzing through communication-knowledge networks. We propose that the process of creating a self propagating content/knowledge network can be enhanced by efficient networking of many conversations of actors in the network. This can then create a digital ecosystem and a dynamic system sustained by many feedback loops. Key aspects of the 'diffusion of innovation' processes are thus the 'dialectic interaction among the 'innovation itself', the 'social system' and the 'communication channels' through which the social system 'members' learn about the innovation and the 'timing' of the processes. Our observations suggest that a knowledge portal such as DEAL best facilitates the process of language reproduction in trust-relationship based framework. We argue that communication builds a different kind of network in a DE i.e., a network of practice (NoP) that creates many conversation loops through discursive interaction of different language communities.

(Paper 1 – An expanded version of this paper has been presented at TATA Institute of Social Science on Social Network Analysis International Conference2008, Mumbai: Tata Institute of Social Sciences.)

Paper - 2
Sociology of Digital Communities: Bridging the Gap between Theories of 'Internet Spectatorship' and 'Rule System Theory'

Social life is regulated by rules. The order of norms regulating human behaviour is considered as the central aspect of society by various scholars. Durkheim considered 'social fact' primarily in normative terms. Here in this paper we try to explore the relationship between theories of 'axionormative' order worked out by Tom Burns and his group broadly under evasion of rules and theories of internet spectatorship. The relevance of these theories to the emerging discipline of Sociology of Digital Communities is discussed.

Broadly, normative changes refer to the replacement or modification of one or more components of the normative structure: norms, values, roles, institutions, institutional complexes. The change of established norms from one state to another is a normative deviation leading to normative morphogenesis. One of the ways through which normative morphogenesis occurs is via norm evasion. There are various mechanisms through which norm evasion occurs at a societal level. One such modality is norm substitution. This primarily occurs when old norms remain in force but evasion occurs because of the magnitude of its scale and occurrence. In the contemporary era, self imagery plays a crucial role in the axionormative order of the society. The quest for a homophiliac search among digital communities has been pointed out by a few scholars. In this context digital content and internet has become a site for structural elaboration through modalities of spectatorship. Based on our field interaction with different actors involved in the use of an ICT facilitated Knowledge architecture in the agricultural domain, we

argue that the process involved in the structuration of digital communities involves principles of normative evasion based on certain rule systems of digital communities. The structural elaboration principles that are likely to set up an emergent 'digital communities rule system' are mediated both through the observational power of the spectator (internet spectatorship) and knowledgeability of the agents.

(Paper 2 - has been published in the in Proceedings of the 2nd International OPAALS Conference on Digital Ecosystem: OPAALS 2008, edited by Ossi Nykanen, Jukka Huhtamaki, Jaakko Salonen, Seppo Pohjolainen and Kirsi Silius, Tampere: Hypermedia Laboratory of the Tampere University of Technology.)

Paper - 3

Services Innovation -Digital Ecosystem Approach to Dissemination and Co-creation of Knowledge for Indian Agriculture Extension Services

Indian agriculture is today at a cross road. Many new diseases, pests and weeds affect the crops. Some old techniques, such as the copious use of irrigation, have resulted in top soil impoverishment. There is a need for innovative practices to be introduced at every stage of the Indian agriculture value chain. The current practices within the Indian Agricultural Extension Service (IAES) focus on a top down approach to services. It largely depends on a traditional F2F service model. This model focuses on instructional model of imparting knowledge to the farmers at the village level. Our past studies across several districts of Uttar Pradesh in India show lack of innovation across the entire IAES system and ill effect of group think. Innovation at the grass root level does not spread across the value chain due to unidirectional approach of the current IAES. In this context ICT provides an opportunity to enhance the service dominant co-creation and delivery in the extension system by providing a set of tools and techniques that are interoperable and easy to use. This paper explores how digital technology deployment projects need to distinguish between organizing explicit knowledge from agricultural experts and researchers (*Gyan Dhara*) in knowledge repositories as opposed to acquisition of field knowledge from farmers, traders and other practitioners (*Gana Gyan*) through participative and circularity of communication.

(Paper 3 – has been accepted for publication in Proceedings of the IEEE CASE 2009, India: Bangalore.)

Background to the Deliverable

The Dialectics in a Digital Ecosystem for Knowledge and Knowledge Sharing Behaviour in a Digital Eecosystem (that Initiates and Fosters Autopoiesis in a Socio-Technical Ecosystem)

Introduction

This deliverable focuses on:

- Knowledge sharing behaviour in a digital ecosystem (that initiates and fosters autopoiesis in a socio-technical ecosystem).

The biological concept of autopoiesis (Maturana and Varela, 1980) and the philosophical concept of meaning were integrated in the work of Luhman (1995) to develop the sociological construct of autopoiesis. Inspired by a text about Don Quixote's dialectical problem of choosing between the path of praxis (action) and the path of poiesis (creation, production) Maturana and Varela created the term 'autopoiesis'. The term embraces their central dialectics of all living systems that is 'cell metabolisim produces components which create a transformational network for transforming the metabolism itself' (adapted from Maturana and Valera, 1998:44).

The term autopoiesis thus, implies that any organism consists of many components and it continuously recreates itself through its components. Every component creates (or takes part in a creation process of) other components, which themselves create again other components and so on. In a living organism, this creation-process is closed, that means all components create each other in a circular organization without help from the "outside". Varela proposed two conditions to formalizes the term autopoietic: (a) all components continuously produce each other (circular organisation) and (b) one or more components build a border of the organism so that the whole system is closed and can be recognised as single unity (structure).

Luhman, while applying autopoeisis to the social context, considered that social systems use communication elements to operate with meaning and thus communication is the elemental reproduction and transformational unit of social systems. His conceptualized social communication system has a dialectical unity of three parts; information, utterance and understanding (Buchinger, 2006:365-366). Thus the digital ecosystem as a socio-digital system can exist only when communication creates more communication through the dialectic interaction between the possibilities created in the inquiring minds of the actors with their actions in the same temporal frame. The context of the study is agricultural domain and the DEAL (Digital Ecosystem for Agriculture and Rural Livelihood) project (www.dealindia.org) that focuses on economic development of North Indian regions thourgh knoweldege sharing

The Indian Agricultural Domain

Indian agriculture is today at a cross road: after forty years of 'Industrial agriculture' based on 'high input technologies', i.e. heavy usage of chemical fertilisers and pesticides with copious use of irrigation, water enhanced production initially, but created many bad side-effects in the long run (see D7.3).

Initially, the so-called 'green revolution' was successful. The country attained self-sufficiency in several crops and across most of the constituent states of India. But the yield growth rates of the 60s and 70s

soon reached a plateau, and declined during the 80s and 90s. Many new diseases, pests and weeds came with imported high yield hybrid varieties and the manipulated hybrids. Beside this, the knowledge advancement showed that some techniques, such as the copious use of irrigation, could end up in soil impoverishment. In this scenario, knowledge creation and sharing, together with new technologies, can play a big role to retrieve growth.

Innovation in Indian Agriculture at every stage of the value chain, from seed to food processing, is a national priority. India needs to innovate and develop its own version of postindustrial agriculture that can effectively meet the new challenges.

The Research Focus

Continuing into the second phase of the DEAL Project, inspired by Luhmann's research on autopoiesis in a social system, we deployed a DEK based on 'conversational learning' (Baker et al. 2002). This conversational learning process is found to be particularly suited for the region (UP in Northern India), where our field observations are located, perhaps because the traditional learning and religious practices in this region are conveyed through generations of 'oral traditions'.

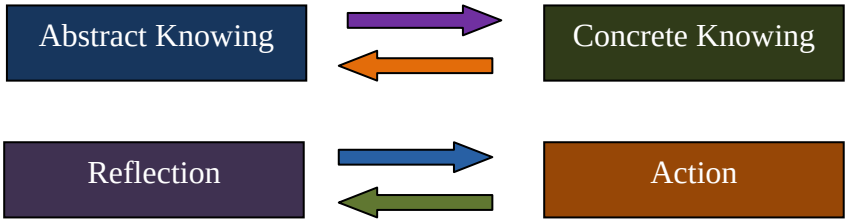
Coversational learning, propagated through Kissan Blog and Krishi Katha (Agricultural Story Telling) not only show some evidence of autopoiesis but also a multilinear model of adult learning through 'the process whereby knowledge is created through the transformation of experience' (Kolb 1984). From our longitudinal observations it appears that Indian Agricultural Extension Services (IAES) also depicts the challenge of adult learning through two dialectically related modes of grasping experience – apprehension (concrete experience of farmers and agri-scientists in the village centres) and comprehension (abstract conceptualisation by agri-scientists in universities and laboratories) and two dialectically complementary modes of transforming experience - intention (reflective observation) and extension (active experimentation).

Our project hypothesis (D7.3), inspired by Luhmann and others, was that these dialectic contradictions could be well improved through facilitation of mutiple parallel conversations and feedback loops as that encouraged the farmers to reflect on their own understanding and adopt problem based learning mode. Thus an integrated learning model was deployed that embraced (rather than choosing one over the other) the dialects of the differing learning styles and intents. This integration was conceptualised as the learning cycle between Gyan Dhara (scientists formalised and encoded knowledge) and Gana Gyan (unstructured, informal and emergent knowledge embedded in topical conversations).

The focus was thus on shaping the autopoietic process of DEK that can use ICT to respond to the learning situation and the learning intent or topic by spanning the four bases of experiencing, reflecting, thinking and acting.

The papers in this complation focus on the Deliverable D11.6, ie. Knowledge sharing behaviour in a DEK. The field experiments are based on the hypothesis that greater the anticipated reciprocal relationships are, the more favourbale will be the knowledge sharing attitude. Rather than extrinsic rewards our system deployment relied on encouraging the sense of self-worth through knowledge sharing behaviour. The expertimental DEAL architecture is based on an assumption that conversation is a 'meaning making' process where understanding is achieved through interplay of opposites and contradictions.

Two basic dialectics that are depicted through the papers in this compilation are –



In the DEAL system the tension between these dialectical pairs generate most conversations. The conversational space is seen as the arena of the autopoietic process through which the social innovation system comes alive and generates self catalysis. Both of the above mentioned dialectical processes must be seen as two different dimensions of the same autopoietic phenomenon in a DEK satisfying the condition of 'no separation between producer and product. The being and doing of an autopoietic unity are inseparable, and this is their specific mode of organisation', (Maturana and Varela, 1987, pp.49).

The experimental applications like Kissan Blog or Krishi Katha that use 'innovation probes' like Nai Dishayen (new findings, new thoughts) provide interesting insights into the dialectic of discursive and recursive in the stake holders' (farmers and scientists) meaning making process. The domain of agriculture extension service in Krishi Vigyan Kendras (Agri-Science Centres - KVK) which is situated upon the tension between the field scientists/workers (balancing active experimentation and concrete experience) and the research scientists in Agricultural Universities and Laboratories (balancing abstract conceptualisation and reflective observation), can be viewed as a product of dialectic of boundary and structure. The KVK subsites within DEAL can be viewed as the socio-digital space between boundaries that define and protect key information where conversation occur and internal processes and norms shape the conversational interaction.

In a conversation driven DEK, the autopoietic process can be seen in the development of norms. As conversations progress there is a paradoxical quality that manifests. (In a way one sees the same process even within the OPAALS wiki and OPAALS community exchanges.

Links between the Papers here and Deliverable Description

The research output from this Work Package as per committment were two investigative papers. Additionally we have included an introductory chapter that contextualise our DEK approach in refernce to agricultural domain. All the papers have been presented to and accepted for publication in the proceedings of International Conferences/Journals after several reviews

Paper 1

Introductory Paper - Digital Ecosystem for Knowledge – An Perspectives and Observations form the DEAL Project

Debashis Pattanaik **Jayanta Chatterjee**

1.1. Introduction

Indian agriculture, that engages more than 60 percent of its total population is a large socio-technical system that previously shown remarkable adaptive faetures over five decades. This complex adaptive system however has lately started to languish and need infusion and diffusion of knowledge driven innovation across the entire value chain – from seed to post harvest practices. This study focuses on the Indian Agricultural Extension Services (IAES) as a knowledgeable network and the impact of infusion of digital technologies on that complex socio-technical system to enable the next stage of adaptive innovation. In that process we explore how such complex activities need to be self-organizing and self-catalyzing (Fukuyama, 1999) and how digital technology deployment projects need to distinguish between organizing explicit knowledge from Agricultural experts and researchers (Gyan Dhara) as knowledge repositories and acquiring emergent field knowledge from farmers traders and other practitioners (Gana Gyan) through participative and nurturing circularity of communication (Luhmann 1992).

1.2. Status of Indian Agriculture

Indian agriculture is today at a cross road: after forty years of 'industrial agriculture' based on 'high input technologies', i.e. heavy usage of chemical fertilisers and pesticides with copious use of irrigation, water enhanced production initially, but created many bad side-effects in the long run. Today, at the threshold of the 12th five year plan - Indian agricultural growth rate has declined to about two percent against a minimal target of four percent required to maintain national food security. Simultaneously, under the World Trade Organization (WTO) regime, India started dismantling restrictions on agricultural imports and exports: nearly 3000 items have been deregulated since 2001. Indian agriculture today faces challenges from dual ill effects of previous planning and today's globalization pressures on farmers and traders (Chatterjee and Pattanaik 2008). Declining yield, restricted availability of farm credit, increasing variety of pests and diseases on one hand, and cheaper subsidized imports from developed countries, on the other hand, call for innovative approaches. In this scenario, knowledge creation and sharing, together with new technologies, can play a big role. Innovation in Indian agriculture at every stage of the value chain, from seed to food processing, is a national priority. India needs to innovate and develop its own version of post-industrial agriculture that can effectively meet the new challenges. Borrowed science will often not work anymore. 'Associative Open Innovation' is needed at grass-root level (Chatterjee and Pattanaik 2008).[1]

India's first green revolution was a spectacular success from many dimensions. Volume of production went up by orders of magnitude for most crops particularly for basic food grains like wheat, rice and pulses through higher acreage under cultivation and vast areas were brought under pump irrigation. New seed varieties like dwarf wheat and dwarf rice were successfully introduced which significantly

[1] Section also appears in P. 31.

enhanced yield per hectare. Yield also improved due to wide spread usage of chemical pesticides and fertilizer. India became a net exporter of many agricultural produce and the national buffer stock for basic grains ensured India's food security. Forty years later, at the threshold of the 21st century the situation has changed. The mismatch between supply and demand has again started widening.

Spectacular rise of India's service sector followed by mining and manufacturing accelerated the Indian economy since the nineties. But the increasing standards of living in India's bustling cities, higher demand of food grains at home and around the world can not be adequately served by declining agricultural productivity at India's country side. This has initiated a complex downward spiral. The availability of arable land has saturated, water resources are severely constrained. And to complicate the situation- over tillage, over irrigation and excessive or wrong usage of chemicals, fertilizers and many other adverse effects of earlier technological approaches have severely impaired India's productivity across the most fertile and irrigated states (Chatterjee et al., 2008). For example in the case of rice, while India's average production per hectare is 2.4 to 2.8 Tonnes per hectare, China produces six Tonnes per hectare (Business Standard 11th April 2008). To meet the growing need of food grains for a rapidly growing nation, India's policy makers have realized that new strategies are needed to enhance the agricultural growth rate to at least four percent from the current level of 1.8 to two percent. This level is essential to sustain a double digit growth rate for the Gross Domestic Product (GDP) while retaining inflation at a manageable level (Chengappa and Vinayak 2007). Key components of this new strategy will be knowledge driven agriculture and innovation for (nonfarm) livelihood development across six hundred thousand villages of India.

This goal of knowledge driven agriculture (to increase production, reduce cost, enhance agricultural profitability and to make Indian agriculture globally competitive), also needs new programmes to reduce rural poverty and inequality, to protect the environment by reversing the degradation of natural resources (like land and water). New programmes are needed towards innovating new forms of rural enterprises that will effectively manage the shift of labour forces, stem the migration to urban slums and will broaden the base of economic growth potential of rural citizens (Chatterjee et al., 2008).

This knowledge driven approach to Indian agricultural reform and rural livelihood generation has been well analyzed in many planning documents. Indian Vision 2020 states that 'the pace of India's future progress will depend to a large extend on its ability to make available the latest and most useful knowledge to vast section of the population' (Planningcomission.nic.in, Last accessed: 02 May 2008). To make good decisions, both extension workers and farmers need information from different sources and often need help to integrate the information. Due to its sole dependency on knowledge and information mainly from State Agriculture Universities (SAUs) and to some extent from Indian Council for Agricultural Research (ICAR) institutes, the present extension largely provides information only on technologies generated in these research stations. However the current agricultural scenario demand an increasing role of enabler forms the extension services. Thus the extension needs to expand its role from technology transfer to include roles such as problem solving, education, and human development (Van Beek 1997). The first step in this requires identification of the different elements in the Agricultural Knowledge and Information System and redesigning this system in a way that information flow among these elements are improved (Hall, et al. 2002). It was felt that 'by infusing knowledge connectivity to human agencies' critical success condition can be created to energize a resurgent rural economic infrastructure (Garai and Shadrach 2006).[2]

[2] Section also appears in P. 31-32.

1.3. ICT as Driver of Agricultural Extension Services

The concept of Information and Communication Technologies (ICT) for rural development has always attracted media and corporate attention and therefore many multilaterally funded projects on this theme have been initiated over the last ten years across many developing countries. Most of these projects focused on establishing info-kiosks in villages and grappled with the initial problems of connectivity, power and other infrastructural issues. Some of them were oriented towards electronically delivered Government to Citizen (G2C) services; some were focused on trade, some on a range of consumer oriented services. Our initial study during 2002-2004 of many such projects led us to believe that to ignite the agricultural and rural livelihood innovation process with knowledge flow, these rural ICT kiosks not only needed network connectivity and electrical power but also the power of appropriate content and applications. Our research hypothesis was that the process of creating a self propagating content/knowledge network and self managed knowledge repository can be enhanced by efficient networking of many conversations. . This can then create a digital community and digital ecosystem and a dynamic system sustained by many feedback loops (Chatterjee et al. 2008). [3]

It is widely recognized that the development of agriculture is mostly dependent on the effectiveness of agricultural extension. Rapid growth of ICT and use of knowledge as a basic power to deal with global competitiveness have revolutionized all learning systems. Cultivating electronically facilitated knowledge and skill revolution is a highly potent strategy to achieve the goals of productive, profitable, stable and competitive agriculture (Chatterjee, Sarkar, and Prabhakar 2008). At one side where there were large scales efforts to develop ICT infrastructure at the other end hardly there are any digital content available in the agriculture domain to use. The importance of digital content in agriculture domain is clearly reflected in the 11th plan policy framework of Government of India. One of the major objectives of the proposed plan is to build capacity of the extension education professionals for increased use of ICT in virtual learning environment. Keeping the structural constraint in mind the policy framework argues for wider user base, increasing applications and greater dependency on ICT in agriculture (11^{th} Plan Policy, Government of India).

1.4. Social Capital and Knowledge Net

ICT mediated development projects, largely depend on ‘social contexts of design, implementation and use’ (Synder and Rosenbaum 1999). The ‘contextually dependent’ nature of ICT’s suggests that similar ICT’s can have different outcomes in different situations’ (Kling et al., 1998). Thus, the ‘social context’ is the fundamental premise in understanding the relationships between people, ICT and digital information, and the setting in which these relationships evolve. A person’s role and normatively expected behaviour cannot be understood in isolation, but only in terms of his relation to wider community. It is this societal sanction that induces trust to social reltionships - members transacting with a particular individual, process information about her/his role (normatively expected behaviour) with reference to the social network he is part and then decision to trust. Portes (1998), observes that, for individuals ‘whereas economic capital is in bank accounts and human capital is inside their heads, social capital inheres in the structure of their relationships’ The importance of social networks is best exemplified in interesting paradox remarked by Granovetter (1985), according to him social capital, manifest in social networks, can make transactions that can’t happen in a free make possible, by lowering the transaction costs – costs of information collection, monitoring, negotiating and enforcing. The role of information communication technology can then primarily be to enhance this

[3] Section also appears in P. 36.

social capital. An ICT intervention provides the community both wider and richer access to information. Greater infusion of information into social networks depends heavily on commmunication technologies. The use of ICT does shape the social structure through discursive loops it constructs by organizing actors in the network into language communities. The internal propensity of this language community continually organizes and reorganizes the language community through an autopioetic mode of discursive formation while maintaining its boundary. The process of organization and its internal dynamics are structured by the social capital that it generates in a network through trust based relationships.

Trust is a willingness to act on the basis of reliance. A thick kind of trust, in which members have high degree of confidence in others role expectations is found mostly in stable and structured communities, such as agri-communities. Such communities have been known as *Gemeinschaft*. In contrast a thin trust with a goal oriented behaviour exists in communities which Toennies called *Gesellschaft* (Adler and Heckscher 2006). For knowledge networks and communities which are like Gemeinschaft we have to enhance evolutionary growth conditions for social capital through trust based relation enhancing system. It has been observed that when knowledge structure is fluid or random face to face (F2F), mobile nets, interactive radio and TVs act as successful modes for generating social capital in a trust based relationship environment. In contrast when the nature of knowledge is explicit social capital depends on dynamic mode of knowledge sharing (Figure 1.1).[4]

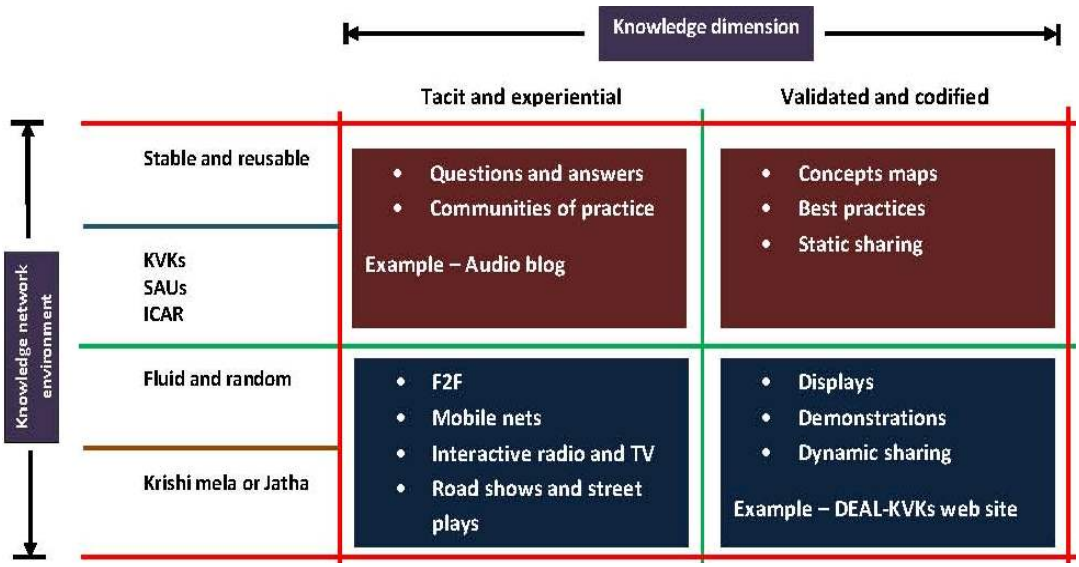


Figure 1.1 – Dialectics of Knowledge Network and Knowledge Dimension.

Key aspects of the 'diffusion of innovation' processes are thus the 'dialectic interaction among the 'innovation itself', the 'social system' in which the innovation is introduced and the 'communication channels' through which the social system 'members' learn about the innovation and the 'timing' of the processes'. The communication is maintained through circularity, organization and reproduction. This requires interoperability of the information. Thus there is a need for digitization of information created in various forms by the stakeholders in the domain. Digitization makes interoperability possible.

[4] Section also appears in P.35.

Interoperability provides potential for automation and systemic self-management. Thus the goal framework in the Digital Ecosystem for Agriculture and Rural Livelihood (DEAL) project focused on semantic interoperability. The goal was to facilitate context sensitive query processing over heterogeneous information sources. The agenda was to build an active-collaborative network of practice, whose interaction e.g. Krishi Vigyan Kendra (KVK=Farm Science Centers) scientists and farmers create new social capital i.e., knowledge based relationship and vice versa.[5]

1.5. Research Methodology

Field deployment of the DEAL project was between December 2006 and June 2007. Further deployment work has been done under the OPAALS project (www.opaals.org) during 2008. We have been conducting studies among participating KVKs, October 2007 onwards. The data used in this paper are taken from the data collected during our field visits at different time intervals. For understanding vertical networks we have collected information from four participating KVKs while horizontal network data were collected from all the five participating KVKs. One KVK was excluded in the vertical network analysis as during the period of data collection it was only participating in the horizontal information sharing.

1.6. Agents and Networks

1.6.1. Agents and Networks -Pre Conditions

The flow of information among actors depends on their structural positions, network relations, and roles within the given social structure (Monge and Contractor 2003). In a most general way the relation between agricultural experts within the same KVK, or between a farmer and his respective KVK while represents strong tie relations, the relation between a KVK and a local Non Governmental Organizations (NGOs) may be of weak ties. Primarily KVKs are innovative science-based institutions which provide vocational training to in-service extension personnel, farmers, farmwomen and rural youths. They also conduct on farm trails for technology refinement and frontline demonstrations of latest agricultural technology to the farmers as well as the extension workers. The KVKs follows the principle of learning through 'work experience' (Khan, 2002). Various type of extension activities such as field days, farmers meetings, Kisan melas, and mass media programmes are under taken by KVKs (Ray 2001). The staffing and manpower of KVKs are regulated by ICAR rules. In an ideal situation there are six Subject Matter Specialists (SMSs) in a KVK followed by a supporting staff four to five members. However in practice it varies widely. For example the KVK at Dhaura, in Uttar Pradesh (a NGO managed KVK and one of the deployment partner of the DEAL project) has six SMS (one of them is Training Organizer (TO) of the KVK) beside a chairman. The TO is main functionary of the KVK. The TO at Dhaura is an SMS of Horticulture. The other five SMS (also known Training Associates (TA) have agriculture related domin specific expetise. Functionally and by practice the KVK is organised in a hierarchical structure. Each SMS is responsible to promote extension activities in her/his domain. On an average this KVK conducts 120 to130 need based training programs on-campus and off-campus in a year for farmers, farmwomen and rural youth (KVK Report, 2006).

The KVKs are expected to work in close coordination with the state agriculture – horticulture - animal husbandry departments, research-educational institutes, NGOs and other agencies working in agriculture (Figure 1.2). They are expected to maintain proper linkage with the district administration and local

[5] Section also appears in P. 35.

institutions engaged in the transfer of technology as well as the input supply system. Success of extension depends on the amount and degree of functional/effective linkages that a KVK has in its structural position. However in reality many of the linkages are dysfunctional due to lack of communication channels among different agents. It is in this context the DEAL project aims to fill the gaps in the communication channels by building networks of practice in the domain through an ICT facilitated information sharing-building platform.

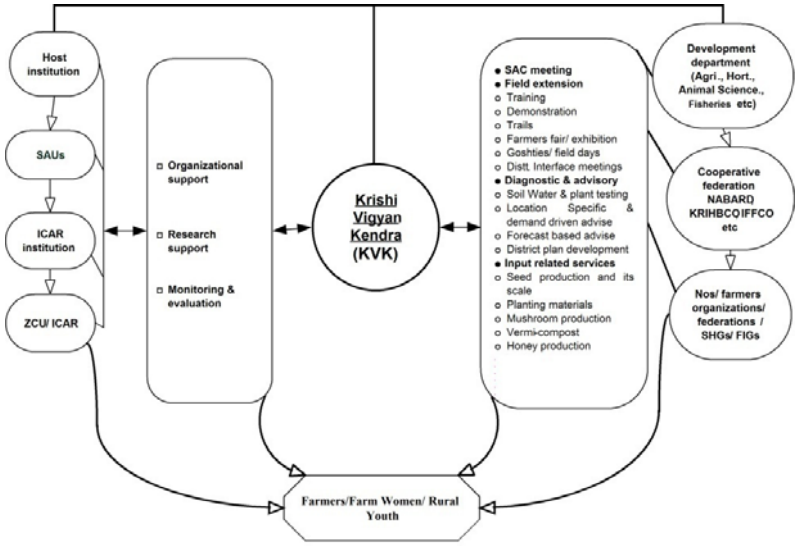


Figure 1.2 - Structural Position of KVK in Extension System
(Figure 2.2 is developed by Dr. Vinod Kumar of OPAALS Project at IIT Kanpur)

1.6.2. Agents and Networks – Pre DEAL Scenario

The positions of actors in the network are based on their roles. The network shows the information flows within a community and across communities. Community here refers to a village unit. Within community linkages are those between actors in the same village – for e.g.; between the farmer of a village and the respective village KVK while across groups' links include links between actors from different villages – e.g. the link between farmers of different villages.

By the strata of operations classification, information flows between members of the same functional role – KVKs are part of the villages' level functionaries, Indian Institute of Technology Kanpur (IITK) is a member of the educational institutions group, and the Zonal Coordination Unit (ZCU), ICAR are all implementation and monitoring agencies. The network diagram (Figure 1.3), shows different sources of agricultural information and the interrelations, both formal and informal, between them.

Formal links are characteristic of the reporting relationship between actors – for instance, in the case of a KVK and the ZCU, and informal links are characteristic of the social relations between actors – like relations between farmers of adjoining villages (Rajagopalan and Sarkar 2008). In a network the reporting relationships between members consists of different layers – administrative, academic and functional. It is found that while there are well established and clearly defined relationships between members from different layers, there are very few formal ties between the members of the same layer. For example, the relationship between the ZCU and a KVK, or between a KVK and farmer is close and

well directed, but there exist no direct links between the four KVKs. Communication is routed through the ZCU, and is conducted F2F at periodic zonal meetings (Rajagopalan and Sarkar 2008).

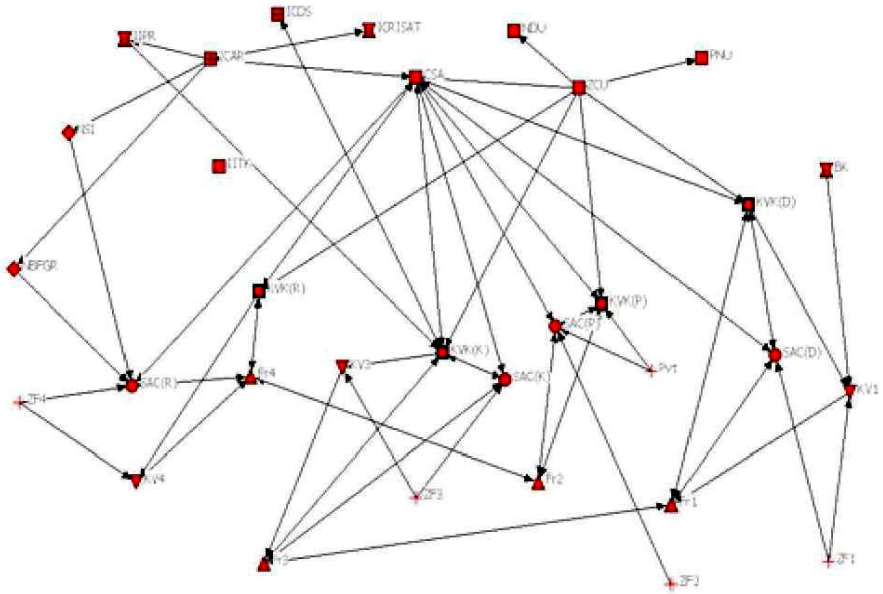


Figure 1.3 - Network Ties before DEAL

In the pre-DEAL scenario, except for the informal links between farmers of neighboring villages, the other links represented in the network are structurally determined. There are very few reciprocal ties between members of the same layer – for instance, the links between Pant Nagar Agriculture University (PNU) and Indian Institute of Pulses Research (IIPR) are both indirect and non-reciprocal (Rajagopalan and Sarkar 2008).

1.6.3. Agents and Networks – Post DEAL Scenario

Figure 1.4 represents the ties after implementation of the DEAL project. New actors are introduced into the existing network through DEAL. Its integration into the network is represented by the arrows between it and other nodes, signifying an increase in information flows. The dotted lines represent ties that have been formed due to content co-creation and sharing by partners that was facilitated by IITK through DEAL, while the solid lines represent the pre existing network ties.

By implication, ties formed through DEAL are mostly weak links. These are voluntary clusters of members who are from different groups. Groups in the network can be understood at two levels – one, at the geographic level, which consists of members of different types (farmer, KVK, research institute) at a specific location, and the other is related to functional relationships. These could include academic ties, administrative reporting relationships (financial flows) or operational ties, for example, between KVKs. Linking together all the actors in dynamic relationships helps retain both strong and weak ties. The total number of ties increased from 77 to 183, and no old ties were displaced. No old actors in the network were deleted after implementing the DEAL, one new node (IITK, the implementer) was added to the network. What was observed was that several weak links were introduced between existing nodes, signifying greater interaction (and hence innovation), and a deepening of community relations. This observation goes along with Granovetter (1985) and Coleman (1988) that t ICT intervention leads to enhancement of social capital (Rajagopalan and Sarkar 2008).

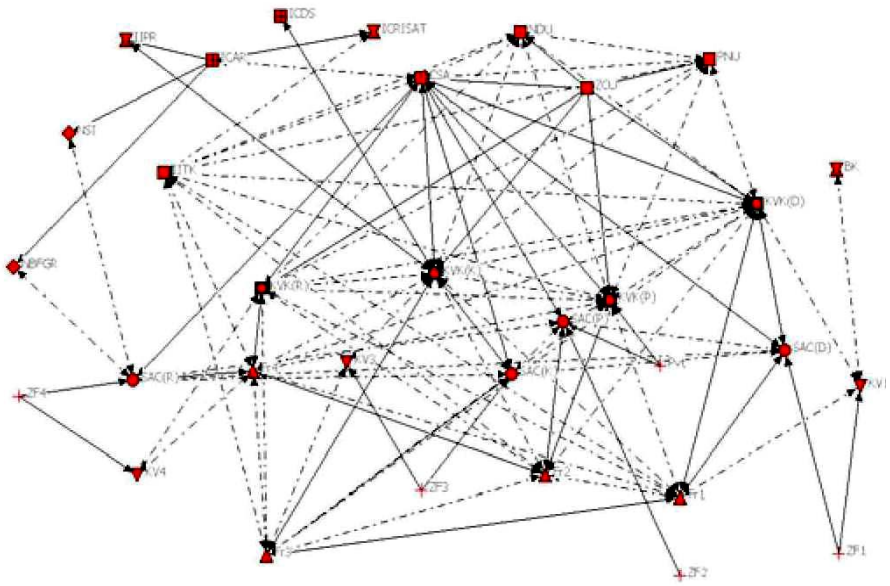


Figure 1.4 - Network Ties after DEAL

1.7. Emerging Knowledge Network-Nai Dishayeen

Nai Dishayeen is a Web 2.0 (blog) application for farmers and extension workers to share knowledge in text format. The purpose of the blog is to disseminate latest technological information and practices to the farmers and extension workers.The blog is deigned through wordpress (a free software-blogging tool). We have used word press as it has many features which are very much similar to office system (the MS office system is the most widely used word processing tool in India). It addition it provides various ways to customize the tool according to ones own need. We have developed Nai Dishayeen as part of the Phase 3 of the WP 11 of the OPAALS Project. The tool is in further developmental stage. The tool was deployed at the portal drunig March 2009. We are evaluationg the portal since June 2009. Our observation shows that Nai Dishyeen as an knowledge networking tool has abilities to fill structural holes by facilitating and flow of knowledge across regions (Figure 1.5 and 1.6).

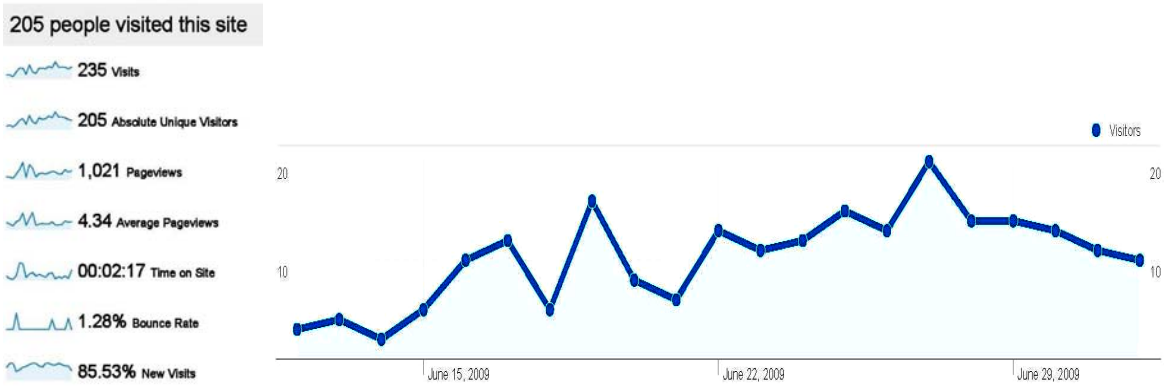


Figure 1.5 - Vistor Statistics for Nai Dishayeen

It is possible to say that Nai Dishyeen as a socio-technical mediator facilitates network of conversions and self amplifying feedback loops. The clouser closure of the network results in a collective consciouness and a context of meaning, which is continually sustained by an autopoietic mode of reproduction.

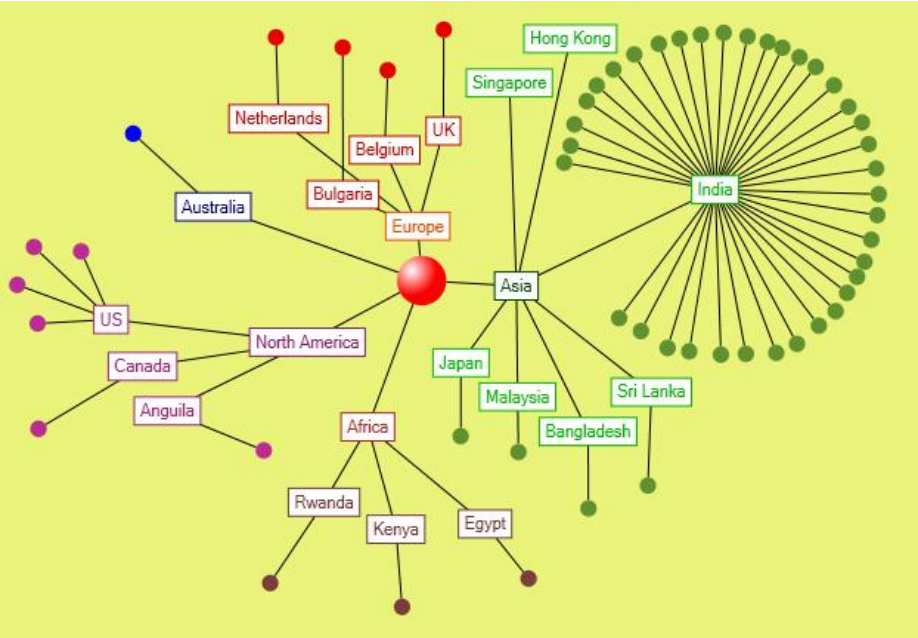


Figure 1.6 – Network and Diffusion of Nai Dishayeen across RegionsVistor Statistics for Nai Dishayeen
Note: The speher in red repreents Nai Dishyeen, The small circles represents agnets in the network. The data presented here are drwn form our observation form 12th June 2009-2nd July 2009.

1.8. Conclusion

The DEAL has been able to create a network of relationship among various scientists for information sharing. There is a constant information flow among both within the groups and between groups both at horizontal and vertical level. This has been done by creating a platform for different KVKs to share their extension experiences with each other through hosting a website for each of them. The DEAL provides multiple digital tools to the user for easir acess of the poratl and voluntary participation. One such application is Nai Dishayeen atthe DEAL portal. Nai Dishayeen holds new possibilities and oppertunities for bottom up participation participationfor the upcoming web technology and use in agriculture and rural livelihood domain. (a) It allows easier facilities for experession of views and knowledge. Thus is based on easy to use and easy to learn mechanism. (c) It ensures collaborative practices for knowledge generation and reuse through intrinsic rewards. Contemporary web 2.0 has empowering effects if it is used as a tool for communication and cooperation in civil society. In this sense DEAL as a web 2.0 application has contributed in restoring the multiple voices of the ordinary rural farmers and extension workers in Indian society. The DEAL experience in expanding the IAES knowledge network and the self catalyzing characteristics exhibited by several applications like the Nai Dishyeen inspire new research interests regarding the role of participative digital communication as enabler for innovation in large complex socio-technical systems. This research project has also renewed our interest in social-biological to realize as to how Digital Business Ecosystem and Digital Knowledge Ecosystem differ and converge as socio-technical innovation system.

Paper 2

Sociology of Digital Communities: Bridging the Gap between Theories of 'Internet Spectatorship' and 'Rule System Theory'

Debashis Pattanaik **Jayanta Chatterjee**

2.1 Introduction

The Internet engages users in cognitively effortful tasks and provides experiences and challenges in ways different form conventional mass media (Newhagen and Rafaeli, 1996). Internet produces spectatorial positions which are rendered through images, different media forms and computer technology. Spectatorial positions suggest that user as a spectator has a high level of agency when engaging with the internet setting. However it is social forces as well as organizing influences of representations and interfaces that create spectators and ascribes observational power to the spectator (White 2006).

Social life is regulated essentially by norms. Durkheim conceived social facts in normative terms (Durkheim 1972). Similar normative emphasis on social life was highlighted by Florian Znaniecki in his 'axionormative order'. According to him 'social order in this view denotes simply axionormative order among phenomena called social . . . The social organization is founded on collectively recognized and supported norms which regulate not only actions but experiences and representations of its members (Znaniecki 1971). Recently Tom Burns and his group have developed a comprehensive theory of rule systems and rule regimes to highlight the importance of social norm and their key position in social life. According to them rule systems are major objects of social transformation (Burns 1987, 1992). Thus we assume that Tum Burns approach to social change provides a good framework to understand the process of social change and collaborative participation in digital ecosystems.

In this paper our aim is to provide a theoretical understanding of the adoption of ICT based on the works of Tom Burns and theories of internet spectatorship in the context of Digital Ecosystem for Agriculture and livelihood web portal (DEAL project) developed by the OPAALS group at IIT Kanpur.

2.2. Theories of Internet Spectatorship

Contemporary digital technology encourages actors to interact, find community, and identify with representations that 'live' within the internet 'space'. Spectatorship affects how settings and interfaces are understood and helps to shape larger conceptions of self and normative structures. An active and empowered internet 'user' is one who is in control of the interface (White 2006).

It is argued that spectatorial web sites aim to address particular kinds of internet and computer spectators by suggesting what they resemble. These renderings of images indicate the kind of representation and spectatorial positions to be produced by internet and computer technologies (White 2006; Mayne 1993). Spectatorship indicates that different forms of media are 'culturally significant events'. It is suggested that a failure to provide aesthetic validation result in 'usership' that has no significant experience and can invite the spectator to critically look at technology, reproduce power discrepancies (Mulvey 1975; Hartsock 1990).

2.2.1. Defining the Term Spectator

Employing the term 'spectator' when considering internet and computer settings indicates how individuals look at representations and/or are acknowledged or displaced by visual and textual addresses. The term involves gaining an understanding of the setting and relates to user experiences through narratives and renderings. However spectatorial positions do not exactly describe the experience of any individual, rather it suggests how the viewers are addressed and shaped by media forms. Spectatorship indicates the processes of watching and listening, identification with the representational schemas; textual or pictorial, the various values with which viewing is invested. Nevertheless, the spectator is subjected to the power of another vision and assumes positions with significant cultural ramifications when viewing internet sites, reading, and listening. In Internet and computer viewing, the forms of spectatorship articulated by the technologies and representations are constantly acted out by using the system (White, 2006).

2.2.2 Reproduction Strategies to Mediate the Self

By and large human efforts to make sense of self and the world are dominated by ideological forces that are oriented towards individual goals. At the same time, particular forms of thinking and action also reveal volitions and genuine motivation beyond the confines of existing social forces. Human beings are initiated into language communities where women and men share bodies of knowledge, epistemologies and the cognitive styles that accompany them. These forces shape understanding of the self and consciousness about who we are. Thus, the manner in which one come to think about education and knowledge production is based on discursive communities. Socio-historical dimensions of self-production are naturally manifested on the terrain of discourses. In very specific terms a critical epistemology is profoundly concerned with the production of self in the context of the influence of power blocs in contemporary society. Such concern reveals itself in a critical questioning of the social, cultural, political, economic, and linguistic structures that shape human consciousness as well as the historical contexts that gave birth to the structures (Kincheloe 2008).

2.3. Norms and Normative Changes

In general norms refer to institutionalization of certain rules and normative change implies the emergence, replacement or modification of components of normative structure. Any change in the established norm requires normative deviation. Merton in his work distinguishes between two forms of deviance: (a) non conforming behaviour and (b) aberrant behaviour (Merton, 1982). Both vary widely in terms of the mechanisms of operation and changes they bring to the social system. Thus non conforming and aberrant behaviour initiates two different paths of normative morphogenesis with different stages and internal mechanisms; one through morphogenesis via normative innovation, and the other through morphogenesis via norm evasion. In this paper we will focus on the first aspect of normative changes. Normative innovation is a subtype of normative emergence where a new additional level of norm appears requiring its institutionalization.

Normative innovation starts with some acts of human creativity and dissent from existing traditions. By nature such acts are exceptional, and occurring only among a selected few societal members. There is a considerable gap between initiation of an innovation, and the time it becomes finally accepted and replaces old rule systems (Coleman et al., 1966). In the beginning the innovation may remain private and attempt to popularize it may fail. In the sub-sequential stages in an evolutionary process it becomes wide spread. Yet this does not mean that they immediately become socially meaningful or consequential. At this stage various social filtering mechanisms may block the innovation. However as

Merton puts it - A certain degree of 'innovation', for example, may result in the formation of new institutionalized patterns of behaviour which are more adaptive than the old in making realization of primary goals (Merton 1968). This paves the way for the innovation to break through the filtering mechanisms and reach wider society. With regular and repeatable characteristics, the innovation gets its legitimacy and opens the path for normative morphogenesis through the process of institutionalization of new norms. Institutionalization of norms at this stage can follow its own path. The success of institutionalization of the innovation leads to the final phase of the morphogenetic process where new norms attain the status of sanctioned norms.

2.4. Tom R. Burns and Rule System Theory

Fundamentally rule system theory is a continuing tradition in the understanding of social change through the principles of normative changes. Following the tradition Burns and his group suggests that social organizations, communities, networks and societies are in a state of normative morphogenesis which they refer to as transformation of rule regimes[6]. They argue that actors themselves are actively involved in these processes to determine which regime or regimes are to govern a sphere of activity or social process. Agents with vested interests struggle to maintain established systems or to limit changes in them. Others, often with diverse motives, engage covertly or openly in modifying or transforming the systems. However, even in periods of radical change, they never start from scratch. Their point of departure is always an on-going socio-cultural system in which they are embedded. **They evolve a future through praxis**.[7] A similar view has been expressed by earlier researchers (Brown and Duguid 2001) that the paradox of stocks and flows in knowledge networks can be resolved through social practice.

Social interaction takes place in settings usually with more or less established social rule systems defining agents' rights knowledgability and access to resources. The structural conditioning of social action and interaction also depends on physical circumstances, which make for a given resource availability and the shaping of action constraints as well as opportunities. Morphogenesis of rule regimes is thus conditioned both by the structure and agential coefficients. It occurs when new rules of an innovative framework are practiced on a large scale by the actors in a given social context (Burns 1987). In the contemporary world, digital technology plays a crucial role in social life. In the following sections, we elaborate on the morphogenesis of rule regimes through discourses of internet spectatorship and our observations from the DEAL project. Before that let us describe on theories of internet spectatorship.

2.5. The DEAL Project

The DEAL (Digital Ecosystem for Agriculture and Livelihood) project is a step towards technology enhanced agricultural extension intervention in a DE (Digital Ecosystem)[8] framework. DEAL is an ICT (Information and Communication Technology) enhanced network built on an existing framework of tele-centers in rural institutes, village schools, KVKs (Krishi Vigyan Kendras -Agriculture Science Centers) and other deployment partners. The project aims to create a digital knowledge base by involving the various actors in the existing system in the content creation process and making this

[6] The term rule regime refers to authoritative, backed by social sanctions and networks of power. They have an objective external quality in human understanding.

[7] **Praxis is the place where theory meets the action. In other words is it accepted practice for human activity.**

[8] A digital ecosystem is a digital environment populated by digital species consisting of software components, applications, online services, information, business models, users, etc having characteristics of biological ecosystem.

knowledge accessible to farmers and other agricultural practitioners. The entire process of content creation and dissemination is capable of self generation, node independence and self-sustainability using an electronic medium. The moderating node in this system is IITK, which provides the collaboration and collation technology platform, skills and resources to assist knowledge flows through the network.

Field deployment of the DEAL project was between December 2006 and June 2007. Some further deployment work has been done under the OPAALS project (www.opaals.org) during 2008. We have been conducting studies among participating KVKs, October 2007 onwards. The narratives used in this paper are taken from the data collected through our field visits during that period to five participating KVKs, and the DEAL. The data used in the present study were collected through personal interviews with the help of an unstructured interview schedule and focus group discussions. The KVK scientists (31 in number) were interviewed at their respective KVKs.

2.6. Contextualizing the Theory and the Problem

2.6.1. Context 1 – Internet Spectatorship and Lessons from the DEAL

The DEAL portal, is aimed at providing agricultural information services. The front page (home page) of portal shows the subjects in the form of farmers, agricultural land, tools and live stock and suggests authority, coherence, control, and engagement.[9] The 'welcome' messages and links - labeled English or Hindi at the front page of the DEAL portal suggests that there is a way for the spectator to get into the setting based on his/her knowledgability. The images relating to agriculture such as farming fields, farmers and agricultural products perpetuate the view that there are subjects 'in' of within internet 'space', and suggests that the spectator has ability to manipulate the technology used in this virtual space.

The visual interface of Kisan Blog at DEAL aims to provide a living environment to the users to look at each other, enter the interface and congregate. For example at the Kisan Blog, as the spectators login to the domain or start a session with the computer, the portal appears with a welcome text which provides information about the portal and how to engage though it.The text existing there informs the spectator that Kisan Blog is a new kind of society where many other people across the country voluntarily join. This suggests that viewers become empowered spectators by entering into the internet setting (of the DEAL) and occupy the internet as a space. Existence of users at the portal which are presented through a list of recent users and commentators suggest that there are 'others' existing in the domain who belong to his/her imagery. This satisfies the homophiliac[10] search for self at the portal.

2.6.2. Context 2 - Rule System Theory and Lessons from the DEAL

Morphogenesis of rule regimes occur when there is a mass erosion of established rules. By practice, the agricultural experts we studied as users of the DEAL portal reside in a rule regime where they are considered as rule-following agents of agricultural extension system without having any need for knowledge beyond field requirements. In various top-down mandated centralized information delivery

[9] The DEAL portal uses various strategies through the use of multiple media to look up the subject. Examples of this are the use of 'grid interface', 'Kisan Blog' and various images and video tapes presented at the portal.

[10] The quest for a homophily by the internet users has been highlighted by a few scholars. The term hemophiliac search suggests that users prefer to see their own reproduction at internet sites. For further details refer to Peter R. Monge and Noshir S. Contractor (2003) Theories of Communication Networks. New York: Oxford University Press.

mechanisms in the existing agricultural extension system, thus there is a 'deskilling epistemology of practice'. Extension agents are told what to do by experts in state/provincial departments/ministries without any evidence that such government mandates will improve the quality of extension services in their specific jurisdictions. The anti-democratic actions of such standardized extension policies threaten the knowledge freedom of extension workers thus reducing their desire to access and use knowledge available through internet. Although this threat is an unintended side effect of such strategies but is a celebrated tactic of dominant power's goal to maintain the rule regime. According to an agricultural expert we studied[11]:

> The duty of an agricultural expert at KVK is field based. All the mandates are designed by ICAR (Indian Council for Agricultural Research)[12]. Primarily we depend on the ICAR for training, information delivery, and access. My participation in the DEAL project was started through our ZCU (Zonal Coordination Unit)[13] at Kanpur. There was little interest of mine as this was not a structured mandate of ICAR.

Under such structural arrangements changes in any rule regime requires both a spectatorial display of the object to be adopted and practiced by the agents in the domain as well as elaborative principles to facilitate the process. The DEAL used both the tactics to create a new rule regime. The first issue was addressed by developing easy navigation/browsing tools and operational features in the portal. The second issue was resolved by providing additional material and training supports. According to a respondent:

> At the time DEAL was implemented at our KVK we did not have a computer with us. The computer we currently have is provided by IIT Kanpur. At the beginning the proposal was to provide content to the DEAL team for digitization at their laboratory. But going to IIT to give content was a difficult task for us. I asked some of my colleagues to do the same. They also expressed similar problems I informed my difficulties to DEAL. They then provided an agricultural scientist for us to collect text based information from us to digitize. . . . In the beginning, I myself had little belief on the success of the digital content. Until September of 2006 we had little experience of the website and the project. During that time they proposed to install the digital content at our KVK. Once the computer came to us some of my colleagues started showing interest in the use of the portal project. What I liked most is the gird interface. It provides an easily searchable way for digital content. The Kisan Blog is another interesting feature of the portal. I feel happy when I see names of farmers and other experts at the Kisan Blog posting questions and providing answers.

2.6.3. Context 3 – Bridging the Gap between Rule System Theory and Internet Spectatorship Observations from DEAL

It is difficult to say that the DEAL portal has really resulted in the morphogenesis of the rule regime. However there are few indications which suggest that it has to some extent enabled the process for mass adoption of the digital content in agricultural domain. According to an agricultural scientist:

[11] All the narrations were translated by the authors to English based on responses in Hindi.

[12] ICAR is an autonomous national organization set up by the government of India to conduct and promote research and training in the field of agriculture and allied sciences.

[13] ZCU is zonal a coordinating unit of ICAR , which facilitates frontline transfer of technology programmes by establishing strong linkages with State Agricultural Universities, ICAR institutes, line departments and voluntary organizations in the zone. It is also responsible for developing, monitoring, and evaluating the works of the KVKs in the zone. The stated ZCU in this paper refers to ZCU IV of ICAR.

> My participation in the DEAL project comes through our training organizer. At that time I and some of my colleagues did not like the idea at all and thought that it was both a waste of time and energy. But I started using the digital content, one day while I was going through the portal, one of the lead farmers of the locality visited us. He found the portal quite interesting and showed interest to use the content available at the portal. His interest in the portal also encouraged me to actively participate in the project. The next task was for me to learn a few procedures relating to digitizing the content. The agricultural expert of the DEAL at our KVK has given me some training. At present the PC is in the room of the training organizer. I have limited chance to use it. One of the best experiences for me was to participate in the audio blog. During the month of October the DEAL agricultural expert told me that they have developed an audio blog where farmers can put the queries in audio format and experts can give answers to them in similar way. This was really very fascinating for me. When I saw my name and other scientists name in the portal it provided me a sense of satisfaction that 'I and my friends are there'. When people saw my name at the portal they asked me about it. . . . Currently all of us here use the audio blog.

The narratives presented here suggest that there exists a relationship between spectatorial positions, self, immediate environment and morphogenesis of rule regimes. Morphogenesis in digital community is a final outcome of the struggle with choice selection and emerging participation for considerable time through a continuous process of internet spectatorship. Internal mechanisms of internet spectatorship include the immediate material and ideological environment, the users comfort level with technology, opinions around the use of technology, social taboos and constraints, and the ways in which participants are socially judged.

2.6.4. Context 4 – Emerging Networks of Practices in the Context of Rule Systems and Internet Spectatorship

Literature in knowledge management and communities of practices suggest in general people in structured Communities of Practice come from background having shared knowledge or shared belief system. In these kinds of structural arrangements people of the community gets benefit of the facility that is available through structural resources and positions. In contrast to it information and communication can build a different kind of network (i.e., a network of practice) by challenging the established rule systems and structural elaborations (Baalen, Bloemhof-Ruwaard, and Heck 2005). A knowledge portal such as DEAL under these conditions bridges the structural holes and contributes to the emergence of a such network of practice.

Our study shows that in a pre DEAL scenario, in the absence of proper channel most of the scientist of the KVK operated in isolation and hardly had any opportunity to gain the information and knowledge about other scientist working in his/her area in another KVK even at the local level. For example in the KVK at Dhaura all the scientists shared reciprocal relationships with an expert of Horticulture as he was the administrative head of the KVK. But on the other hand many individual scientists operated with minimal links with others (Figure 2.1). Particularly the expert of Livestock Husbandry and Home Science operated in isolation where as the Agronomist, Plant Protectionist, Farm Manager and Soil Scientist had unitary information sharing. Further more individual scientists at the KVK hardly have any opportunity to share information with other scientists at another KVK. These forms of sparse relationships fail to meet the present context of rapid changes that affect agriculture.

The lack of reciprocity among experts of different KVKs reflects the current top-down approach of information dissemination in agricultural extension system in India. Studies in network architectures suggests participatory bottom-up approach for effective communication and information sharing in commmnication networks (Fahey and Prusak 1998; Markus 2001; Kwok and Gao 2004; Monge and

Contractor 2003). In this context DEAL as a socio-technical mediator facilitates the bottom up approach for knowledge sharing to the people form different organizations (Pattanaik, Chatterjee and Sarkar 2008).

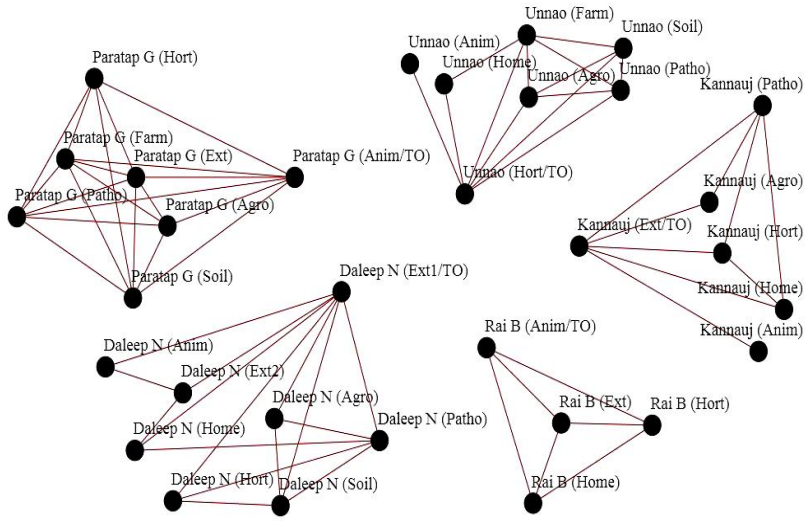


Figure 2.1 – Network in Pre DEAL Scenario

Closely related to the socio-technical (DE architecture) system is advanced information technology and Knowledge Management Systems that supports the process of knowledge sharing (Voelpel, Dous, & Davenport, 2005). However technologies and platforms alone, however, are not adequate enough to for effective participation. The complexity of knowledge-sharing activities shows that effectiveness is the outcome of different situational elements. What makes such forms of social web (knowledge sharing platform) so important is that it permits communications more efficiently and less expensively than ever in the past.

Communication is less about creating contained and controlled messages and more about creating environments to which people are attracted and participates voluntarily. Our experiment with DEAL shows that scientists and other domain stakeholders, by playing the dual role of knowledge processors, that is, by functioning both as the “source” and the “recipient” at the portal enable an empowering mechanism that results in voluntary and bottom participation by different agents of the domain. This also provides a space to the agents to make right decision concerning what to share, how to share in the network of practice. Also, more and more number of agents joins the network and a high frequency of communication takes place collectively they understand the positive the value of the kwoldge sharing/incoming knowledge, thus, achieving a bottom up participatory network of practice. The incoming knowledge also acts an an incentive that increases the willingness of the agents to participate further and contribute to the portal. It urges team members to search, discuss, and evaluate and share.

Figure 2.2 shows the emergence of a network of practice in a post DEAL scenario. There is a significant increase in information sharing/flow among domain experts of different KVKs among both within the groups and between groups. The most isolated nodes (domain experts of Livestock Husbandry and Home Science) of pre DEAL scenario are closed knitted a network of relationships with other domain

experts beyond their own KVKs. This has been done by creating a platform for different KVKs to share their extension experiences with each other through their interconnected web based knowledge repositories

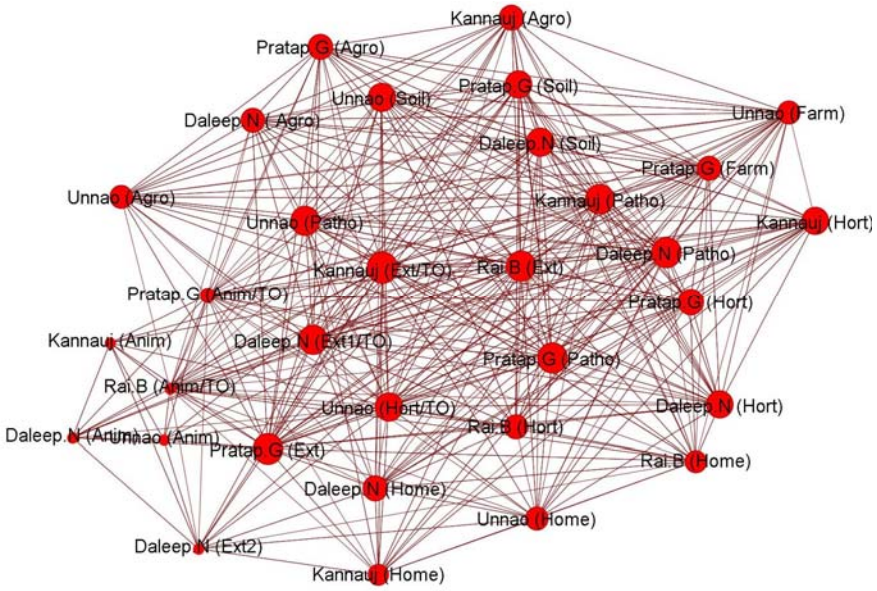


Figure 2.2 – Network of Practice in Post DEAL Scenario

Note: D – KVK Daleep Nagar K – KVK Kanauj P – KVK Pratapgarh R – KVK Raibareily U – KVK Unnao Terms in the bracket indicates designation or subject area specialization of the scientists.

The emergence of network of practices occurs through two modes of structure building: (a) internet spectatorship (b) structural conditioning i.e., emergence of a network of practice. The DEAL in this case provides a double conditioned mode of freedom to the actors; freedom to and freedom from. In terms of 'freedom to' the DEAL gives the actors ample space to act in a digital technology facilitated architecture by providing multiple opportunities through spectatorial positions and 'freedom from' constraints by bridging the structural holes and challenging the established rule systems.

2.7. A Framework Linking Morphogenesis of Rule Regimes and Internet Spectatorship

Our aim in this paper was to present a theoretical frame work based on theories of internet spectorship and the works of Burns and his group for the emerging discipline of Sociology of Digital Communities. A suggested model for the framework is presented in the Figure 2.3.

We suggest that digital communities are networked communities at a virtual space holding social characters. By nature of their formation digital communities are considered as innovative and deviant. The structuring of digital communities occurs through existing power structure, socialization and strategic structuring. The existing power structure determines the pattern of networking; resource use and restructuring of the digital community.

However, as discussed in the paper, formation of a digital community largely depends on physical digital ecosystem resources available to the agents. The relationship between physical digital ecosystem and digital communities are reflexive in nature, i.e., one shapes the other through principles of physical

ecosystem structuring. This implies that as more physical digital ecosystems become available the digital community starts expanding and vice versa.

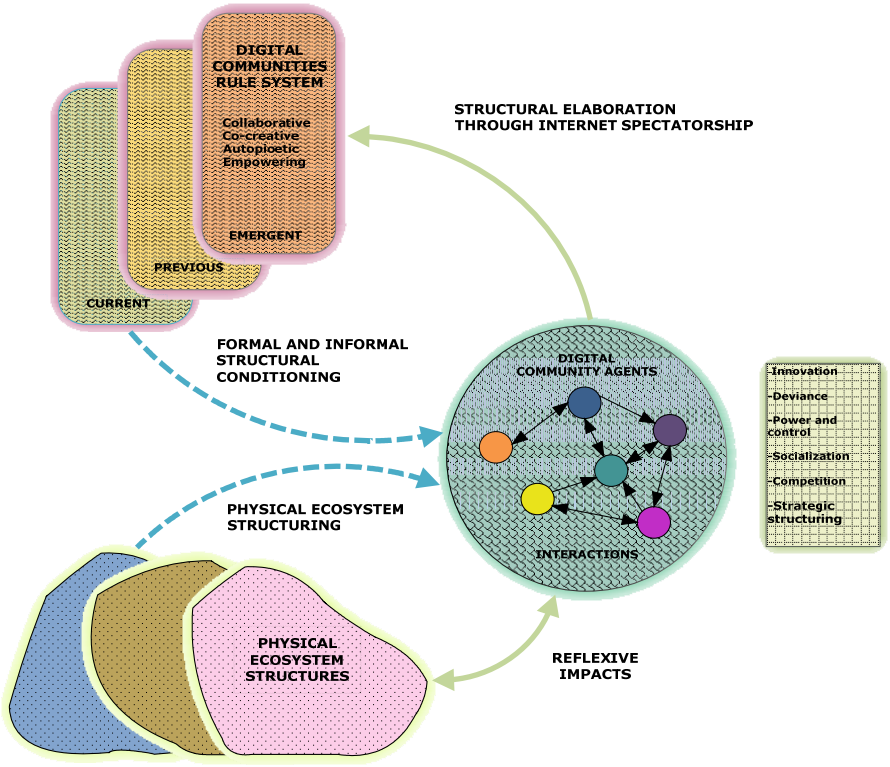


Figure 2.3 – Digital Communities Rule System

Note: The Figure has been conceptualized and developed by us using Smart Draw Version 6. The style and arrangement of each component has been developed form Tom R. Burns and his groups' contributions. Reference: Burns 1987.

The morphogenesis of an existing rule regime to an emerging digital communities rule system largely depends on context specific structural elaboration principles. In our context (and perhaps in other DE platforms too) the principle is regulated by the spectatorial positions and power that agents acquire through internet viewing. However, one cannot deny the importance of the formal and informal structuring conditions that shapes the digital communities, because digital communities emerge and operate in an existing rule regime. It is the structural elaboration which occurs through internet spectorship paves the way for institutionalization of digital community rule system. Its seductive power gathers a larger group of spectator and seduces them to use the internet portals in a repetitive manner resulting to morphogenesis and establishment of digital communities rule system and an associated new rule regime.

2.8. Conclusion

Similar to any other community, digital communities begin their operation within existing rule regimes, for example, the KVK scientists discussed in this paper. However once they begin to operate they start to deviate from the existing rules through the structural elaboration principles facilitated by the

mechanism of internet spectatorship. The seductive power of this mechanism in a sense empowers the agents to challenge the established rule/normative order conditioned by formal and informal structural conditioning. It is this seductive power which also promotes institutionalization of the new norm/rule leading formation of (a) network of practice and (b) digital communities' rules system for network of practice consisting of collaborative, co-operative, autopoietic, and empowering properties.

When a socially empowering technology platform such as DEAL is introduced to a close normative social structure such as agriculture the rule system changes in evolutionary sequences beginning with initiation of an innovation to its legitimation and subsequent morphogenesis of the rule system and praxis. One of the ways through which such morphogenesis and praxis occurs is through the formation of network of practices. Network of practice in this sense is not just a community of knowledge sharing rather it is an innovational community that facilitates new rule systems.

Paper 3

Services Innovation -Digital Ecosystem Approach to Dissemination and Co-creation of Knowledge for Indian Agriculture Extension Services

Debashis Pattanaik Jayanta Chatterjee

3.1. Introduction

Indian agriculture, that engages about six hundred million people across the vast expanse of the sub continent is a large socio-technical system that has earlier shown remarkable adaptivity. This complex adaptive system however has lately started to languish and need infusion and diffusion of knowledge driven innovation across the entire value chain.

We have witnessed a communication revolution that has fostered a wholesale shift in the social order. Originating in Japanese observation, in the notion of johoka-shakai, translated as "information society", its influence has been profound (Duff et al. 1996). Its most enduring developments have been highlighted in the scholarly works of Daniel Bell. According to Bell the post industrial tag is characterized by the central importance of information and theoretical knowledge and by a shift from a goods producing to a service society (Bell 1979). As we move forward in this new society the demand for agile, automated and scalable services accelerate. This study focuses on the Indian Agricultural Extension Services (IAES) as a knowledge network and the impact of Digital Information and Communication Technologies on that complex socio-technical system. In that process we explore how such complex activities need to be co-creative and self-organizing (Fukuyama 1999) and how digital technology deployment projects need to distinguish between organizing explicit knowledge and acquiring emergent field knowledge from farmers and other practitioners for agile, automated and scalable technological solutions and knowledge services (Luhmann 1992).

India's first green revolution was a spectacular success. Volume of production went up by orders of magnitude for most crops particularly for basic food grains like wheat, rice and pulses through higher acreage under cultivation and vast areas were brought under pump irrigation. New seed varieties like dwarf wheat and dwarf rice were successfully introduced which significantly enhanced yield per hectare. Yield also improved due to wide spread usage of chemical pesticides and fertilizer. India became a net exporter of many agricultural produce and the national buffer stock for basic grains ensured India's food security. Forty years later the situation has changed. The mismatch between supply and demand has again started widening. The increasing standards of living in India's bustling cities, higher demand of food grains at home and around the world cannot be adequately served by declining agricultural productivity at India's country side. This has initiated a complex downward spiral. More and more land is needed for industrial expansion. Water resources are constrained. And to complicate the situation- over tillage, over irrigation and excessive or wrong usage of chemicals, fertilizers and many other adverse effects of earlier technological approaches have severely impaired India's agricultural productivity (Chatterjee et al 2008). To meet the growing need of food grains for a rapidly growing nation, India's policy makers have realized that new strategies are needed to enhance the agricultural growth rate to at least four percent from the current level of 1.8 to 2 percent. This level is essential to sustain a double digit growth rate (Chengapa and Vinayaka 2007). Key components of this new strategy

will be knowledge driven agriculture and innovation for livelihood development across six hundred thousand villages of India. This goal of knowledge driven agriculture; to increase production, reduce cost and enhance agricultural profitability; to make Indian agriculture globally competitive, also needs new programmes to reduce rural poverty, inequality and to protect the environment by reversing the degradation of natural resources. New programmes are needed towards innovating new forms of rural enterprises that will effectively manage the shift of labour forces, stem the migration to urban slums and will broaden the base of economic growth potential of rural citizens (Chatterjee et al 2008).[14]

To make good decisions, both extension workers and farmers need information from different sources and often need help to integrate the information. Due to major dependency on State Agricultural Universities (SAUs) and to some extent on Indian Council for Agricultural Research (ICAR) institutes, the present extension service largely provides information and knowledge only on technologies generated by these research stations. However the current agricultural scenario demand an increasing role of international knowledge sources as well as better visibility of local solutions developed by innovative farmers. Thus the extension service needs to expand its role from technology transfer to include roles such as self catalyzed problem solving, education, and human development (VanBeek 1997).The first step in this direction requires identification of the different elements in the Agricultural Knowledge and Information System and redesigning this system in a way that information flow among these elements are improved (Hall 2002). It was felt that "by infusing knowledge connectivity to human agencies" critical success conditions can be created to energize a resurgent rural economic infrastructure (Garai and Shadrach 2006).[15]

3.2. Contemporary Extension Services and its Limitations

The first official extension service system had its origin in the Potato blight in Europe in 1845. The idea then was to improve potato cultivation and grow other nutrients crops in the region. Extension service system in contemporary era aims at the process of linking researchers (and other innovations) with potential users of research results. The plan had appeared in the US Land-Grant University system. The focus was on 'transfer of technology' from the expert to the user. In this mode of operation the extension staffs persuade the farmers and other practitioners to adopt a new way. The US system was exported to India in the second half of the twentieth century. Following it India adopted the 'training and visit' (T&V) approach to the extension service system supported by United Nations (UN)[16]. T&V had attempted to streamline the traditional extension system through three kind of extension: (1) concentration on a few 'contact farmers' in a service area, (2) concentrating on agricultural matters exclusively and (3) concentring on a few practices during each regular visit of village extension worker (Colle 2008). A dominant assumption of the extension service system is that individuals will adopt new practices and technology 'if only they understand what is advocated and know how to carry it out' (Andreasen 1995). Thus the contemporary extension service ignores farmers' perception of their needs. Mismatches between their needs and those presumed by the researchers are not detected. Studies from India highlights the following features of contemporary extension service system (Colle 2008):

1. *Direction of information flow*: Information is supplied from top to bottom and centre to field.
2. *Relevance of information:* Information often is not relevant because of the mismatch between scientists' perception and farmers' expectations about reality.

[14] Section also appears in P. 12.
[15] Section also appears in P. 13.
[16] UN – United Nations

3. *Character of agricultural information:* The message tend to be narrowly suited to production of few particular commodities rather than farmers concern
4. *Overall character of extension information:* Extension service packages largely concentrate on technical and production aspect of agriculture ignoring the whole farmer.
5. *Clientele:* Extension services focus only on particular agricultural populations (big farmers).
6. *Control of the system services*: The agenda of extension services are controlled by managers and scientists to the exclusion of being farmer centred.
7. *Method used to reach farmers:* A greater emphasis is on face to face contact, with little attempt to integrate communication media.
8. *Cost of the system services:* A labour intensive face to face extension service delivery system is very costly to sustain.
9. *Lack of results:* There is no significant evidence to support the claim that T&V extension service system is increasing agricultural productivity.
10. *Inadequately trained extension agents:* Extension personnel tend to be trained in technical areas but have not been effectively trained in communication.
11. *Incentives for extension personnel:* There are few incentives beyond monetary rewards to perform at the level expected by the system.
12. *Evaluation and Monitoring of extension:* Better training, planning and computerizations are necessary to effect better monitoring
13. *Extension funding:* Extension is underfunded and that results in unfilled extension lines which results in inadequate coverage for farm population
14. *Linkage to research:* The link itself is weak, and where it exists at all, the relationship tends to be dominated by scientists.

Such practices in the IAES reflect ongoing practice of inadequate information flow reflecting self-interested data distributed by those with the most power and resources. In contrast there is a need to develop service delivery system in a way where wide audience can gain access to the multiple and complex factors that shape contemporary knowledge and the concurrent production of ideological consciousness. We assume that contemporary extension services in India represent modes of oppression emerging from dominant power in built in the structure.

In this context Information and Communication Technology (ICT)[17] provides an opportunity to enhance the service dominant co-creation and more relevant delivery in the extension system by providing a set of tools and techniques that are interoperable and easy to use. The current extension services demands the participatory model that incorporates the concept of integrating multiplicity of approaches. It stresses the importance of everyday practices of local communities and of democratization and participation at all levels. It points to strategy, not merely inclusive of, but largely emanating from, the traditional 'receivers'. It refers to what Paulo Freire has suggested as the right of all people to individually and collectively speak their word (Freire 1970).

3.3. ICT Facilitated Knowledge Service – The Need

In the formal setup of IAES delivery system the knowledge possessing agents (extension agents and farmers) are seen as mechanical entities governed by fixed and discernible laws. The fundamental assumption is that no matter where they operate the prescribed method will work. The role of the

[17] ICT – Information and Communication Technology

extension agent and farmer is to learn 'best practices' from the experts and to put their dictates into practice. In various top-down and centralized information deliveries in the contemporary agricultural extension thus famers and extension agents are told what to do by experts in state/provincial departments/ministries without any evidence that such government mandates will improve the quality and productivity of Indian agriculture. The antidemocratic actions of such standardized extension policies have threatened the knowledge freedom of farmers and extension workers. Such simple, service delivery system ignores the complexity of the profound diversity of agricultural and cultural practices across the country. The complexity of extension services demands a critical view of knowledge and a synthesis of many dialectic of knowledge flows. Thus a well designed extension service must not only be multidimensional and sophisticated but must also be able to address diverse settings from the different vantage points. The ability to accomplish such a complicated task successfully cannot be mandated by top-down edicts. Studies in development communication suggest that planned and systematic use of multiple media tools (supported by ICT) can enhance the pedagogical and communication capabilities of the agents to dialogue more effectively and interactively with different audiences (Servaes 2008). When ICT mediated networking technologies are introduced to a stable and relatively extension service such as agriculture, the simultaneous interaction of many variables generate the possibilities of creating patterns of self organizing behaviour through many conversation loops. Whether human social systems can self organize, self propagate, evolve, as a 'living system' has been attractive to many researchers. Luhman addresses the issue in the context of an autopoietic human social system. Luhmann's contribution was to identify the social processes for this as conversation/communication (Chatterjee et al 2008).

3.4. Conversation, Self-production and Autopoiesis

The key point about conversation lies in its self production. The term self-production has biological roots. It refers to systems where the components of the system participate in the processes of production that produce those same components that themselves constitute the system (Varela 1981, Maturana 1981).In general self producing systems have a circular organization where the outputs of the system are its own inputs (Mingers 1995).

Self production in social context has a very specific meaning. Luhmann applies the idea of self production to social elements including communication systems through his social system theory. Luhman identfies communication as an self-produccing and autopoietic system. According to him communication occurs throug modes of circular organization (Luhmann 1990). He suggests that communication exists as a unity constituted by three elements: information, utterance and understanding (Luhmann 1995). These elements exist in a mutual interactive field as they are co-created within the process of communication (Luhmann 1990). Luhmann's conceptualizes communication at a higher level of abstarction than general perceived notion of communication. However conversation occupies a central position in his framework. A significant aspect of Luhmann's conceptualization of social systems, and within that organization, is the notion of expectation and its relationship to the way the system is structured and decisions form. As such, self-referential social systems structure themselves through conversations and expectations of actions (Luhmann 1995). This framework provides valuable theoretical support to the development of Digital Ecosystem for Knowledge (DEK)[18] that dynamically enhances 'self production' balances 'knowledge stocks' and 'knowledge flows' in socio-technical systems.

[18] DEK – Digital Ecosystem for Knowledge

3.5. Services Innovation and ICT Mediated Architecture

An ICT intervention provides the community both wider and richer access to information. It infuses information into social networks with greater speed and density. The use of ICT shapes the social structure through recursive loops. The internal propensity of the community (community of ICT users) continually organizes and reorganizes by networked communication channels produced through an autopoietic mode of communicative action while maintaining its boundary. In this context ICT helps us to propagate 'words of mouth' and enhances the knowledge exchange based relationship through circularity of communication and expands the reach and thickness of network provided we focus on 'relation building' and make it person oriented rather than technology oriented. It has been observed that when knowledge structure is fluid or random face to face (F2F), mobile nets, interactive radio, and TV act as successful modes for generating conversations and propagating word of mouth in a relation building environment. In contrast when the nature of knowledge is explicit conversation depends on dynamic mode of knowledge sharing (Fig. 3.1).

Key aspects of the 'diffusion of innovation' processes are thus the dialectic interaction among the 'innovation itself', the 'social system' in which the innovation is introduced and the 'communication channels' through which the social system 'members' learn about the innovation and the 'timing' of the processes. The communication is maintained through circularity, organization and reproduction. This requires interoperability of the information (interoperability provides potential for automation and systemic self-management) and digitization of the information in various forms for easy use created by many stakeholders in the domain. The goal framework of the DEAL[19] (Digital Ecosystem for Agriculture and Rural Livelihood, [www.dealindia.org]) project focused on interoperability of the information. The goal was to facilitate communication through context sensitive query processing over heterogeneous information sources. The agenda was to build an action oriented network supported with multiple ICT tools and technologies. The aim was to facilitate interaction among KVK (Krishi Vigyan Kendra = Farm Science Centre) scientists and farmers for creating new knowledge based relationships (Pattanaik and Chatterjee 2009). [20]

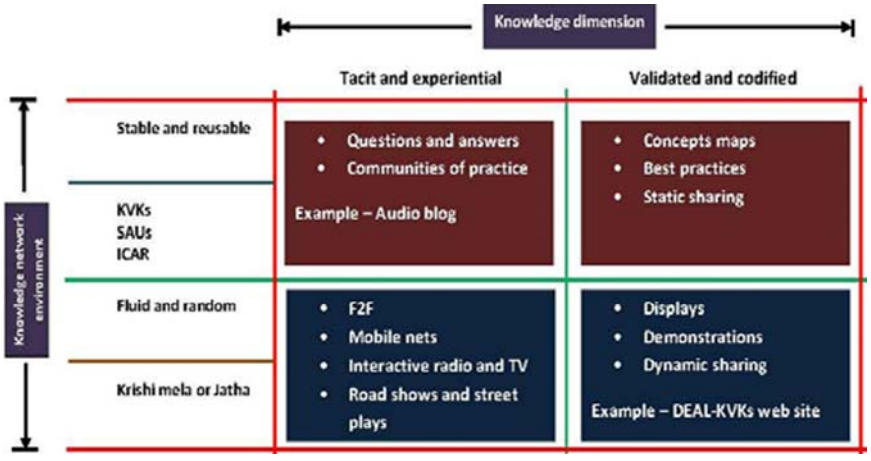


Figure 3.1 - Knowledge Network Environment and Knowledge Dimension

[19] DEAL – Digital Ecosystem for Agriculture and Rural Livelihood.
[20] Section also appears in P.15-16.

3.6. The DEAL Perspective

The concept of ICT for rural development has always attracted media and corporate attention and therefore many multilaterally funded projects on this theme have been initiated over the last ten years across many developing countries. Most of these projects focused on establishing info-kiosks in villages and grappled with the initial problems of connectivity, power and other infrastructural issues. Some of them were oriented towards electronically delivered Government to Citizen Services; some were focused on trade; some on a range of consumer oriented services. Our initial study across north Indian locations during 2002-2004 of many such projects led us to believe that to ignite the agricultural and rural livelihood innovation process with knowledge flow, these rural ICT kiosks not only needed network connectivity and electrical power but also the power of appropriate content and applications.

Our research hypothesis was that the process of creating a self propagating content/knowledge network and self managed knowledge repository can be enhanced by efficient networking of many conversations to build action oriented network (digitally enabled) communities. This can then create a digital ecosystem and a dynamic grass root innovation system sustained by many feedback loops (Chatterjee et al 2008). The DEAL perspective starts from the assumption that ICTs can play an important role in catalyzing development. In this statement we immediately recognize different possibilities of interpretation. [21]

If we focus on the technological aspects, we might expect efficiency improvements in those processes that can most easily be automated, such as information storage and retrieval or any of the other processes that support the business and economic life of the users of DEAL. Development in this case tends to be interpreted in terms of quantifiable economic measures. If, on the other hand, we focus on the communication processes enabled by the technology, we are led to inquire into the nature of the link between the social processes supported by ICTs and the different kind of possible economic interactions and exchanges. These two perspectives reflect a dichotomy at the heart of research on ICTs that corresponds to the main epistemological viewpoints in the current OPAALS-DEAL project (Leon and Dini 2008).

3.7. Research Methodology

Field deployment of the DEAL project was between December 2006 and June 2007. Some further deployment work has been done under the OPAALS project (www.opaals.org) during 2008-09. We have been conducting studies among participating KVKs, October 2007 onwards. The data used in this paper are taken from the data collected during our field visits at different time intervals.

3.8. Kisasn Blog – Audio Blog Initiative for Many Conversation Loops

Kisan blog is a Web 2.0 application for farmers and extension agents to exchange knowledge with other practioners and domain experts through digital channel. It aims to capture and digitize local/tacit knowledge at real time without distortion of the information (Pattanaik and Sarkar 2008). The interface of the Kisan blog focuses on conversational mode of communication and easy to use. At the top left hand corner of the main page there are a few clickable links that provide information on ‘how to use’ to new users. Users can put up their question/knowledge either by uploading a pre-recorded question by directly speaking to a microphone attached to a computer linked with internet, after making initial login to the system.

[21] Section also appears in P.14.

To login to the system a user is required to click on the login option of the blog portal. The blog has a fixed login id and password for common users which is given at the bottom of the login page. However participating KVKs has been allotted with separate login ids, this has been done to ensure authenticity and identity of the participating KVK user. Currently the usual time period for direct recording is 250 sec, and up loadable audio file is limited to 2mb (the aim is to reduce the load in the server). After the recording is done, the user can check the same for quality, clarity etc. by clicking on the option play. Additional features to improve the voice recording quality can be accessed through a click on right mouse button. Once the recording is done the user can submit the recorded file by clicking the submit button. The user is then carried to a page where the user can give a title and other relevant information (such as her/his name, place and description of the file) to his audio clip in visual text format. This is also supported by an on screen key board (in Hindi) for easy use of the user. This supplementary information appears at the blog in text format along with the audio clip when it is transmitted in air. When this is done it is automatically stored at the server of DEAL.

However to be on air it requires an administrator's permission. The administrator has separate login id and follows the same login procedure. He filters the relevant questions and puts them on air. Currently the filtering is usually done by the agricultural experts of DEAL. This has been done with an intention to ensure that the knowledge shared is valid and appropriate.

Figure 3.2 - Interface of the Kisan Blog

Once on air the posting appears on the blog site with title, description and the audio. Users interested for further exchange of knowledge to a specific posting can do so by clicking on the option 'number of suggestions' which appears at the bottom left of the specific posting. To participate further in a posting one follows the same recording method. However follow up exchange of knowledge does not require any login. The names of the most recent users along with associated information related to their designation, expertise, etc. are categorized and appear at the top of the main page of the *Kisan blog*. This ensures authenticity of the knowledge shared as well as acts as a form of intrinsic reward in the form of recognition to the person.

3.9. Kisan Blog – A General System View

Our study shows that as a digital mode of communication the audio blog follows a general system principle in its operation. The audio blog by principle is a purposive system – the input to the system is internally processed and transformed to an out-put while maintaining its boundary (one communication leading to another). The take off occurs after some initial static condition of triggering of the system. Once the take off starts the system jumps to a state of complementary pairing of actors in the domain. The jump start occurs with the appearance of powerful brokers in the network. In the case of Kisan blog the brokerage represents participation of domain experts in the network. As the amount of complementary pairing grows within the network the complexity within the system also increases. At this point the system starts maintaining it through self amplifying feedback loops of ongoing conversation. This gives the blog a self - organizing and autopoietic character by maintain circularity of conversation (Fig.3.3).

Kisan Blog holds three possibilities for the upcoming web technology and use in extension service system; (1) it allows capturing the tacit knowledge in its pure form. The distortion of the knowledge does not occur as it is mostly in audio format and is directly added to the portal. (2) It is based on easy to use and easy to learn mechanism. (3) It ensures collaborative practices for knowledge generation

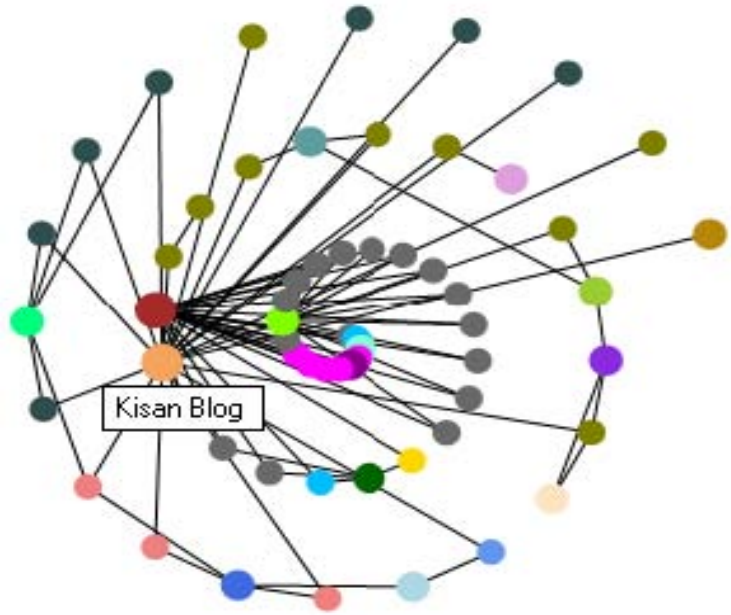


Figure 3.3 - Conversation in Kisan blog

Note: The Network diagram presented shows organization of conversation of only two knowledge objects of the Kisan Blog. The box in the diagram represents Kisan blog. The larger circles in red orange shows the knowledge objects and the small circles represents agents in the network. We have used Pajek V 1.24 to develope the diagram

3.10. Krishi Katha

Krishi Katha is a mobile supported application for farmers and extension agents to exchange knowledge with each other in asynchronous communication. The new mobile communications technologies are fundamentally rewriting the spatial and temporal constraints of all manner of human communications. As organizers of cheap, flexible, always-available communications mobile nets have

capabilities to make decision-making and management of extensions services more decentralized and much or more coordinated than before. This decentralization can create new and potential interactions between individuals that can dramatically speed the metabolism of diffusions of innovations in the extension service system. Krishi Katha uses the contemporary mobile technology blended with other ICT tools and applications to reach out to farmers and extension workers in an easy and interoperable way.

To use Krishi Katha the users only needs an active mobile phone. The users are required to call to a specified telephone number (the number of the telephone attached to Krishi Katha server) to post their query/information. After dialling the number the users receives a set of queries relating to his identity and issues he wants to address. For example the user is requested to press key 1 if her/his query relates to query for crop or 2 if pulses. Once these steps are completed the user is requested to speak his query which is then directed to the Krishi Katha server (voice call server) repository and the user is assigned with a token number. The query is then forwarded from the voice call server to the SMS server of the Krishi Katha and registered Krishi Katha domain experts (here experts of the participating KVK) get an SMS alert about the query. The expert then provides the answer to the query thorough his mobile (in asynchronous time). The answer is then stored at the Krishi Katha server and mechanically aligned to the specific token number and SMS, the user instantly receives an SMS alert about 'reply to his query'. The user can then use his mobile and token number to listen to the answers given by different experts (registered experts) to his query. The experimental beta version of Krishi Katha is completed and deployment work is in progress.

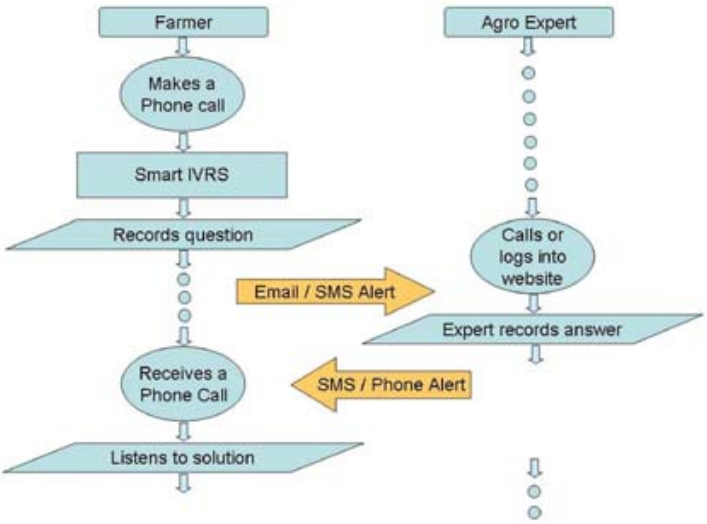


Figure 3.4 - Architectural Design of Krishi Katha

Krishi Katha is the fulfillment of latent demand of IAES to foster innovation across regions at low cost and easy to use way. Krishi Katha aims to break the flow of information away from the scheduling necessary to ensure coordination of journeys. Information could be updated both in real and asynchronous time, negating the need to plan anything in advance which does not work any longer in the contemporary changing scenario of agriculture and environment. It makes accessibility much easier. We assume that this new reconfiguration of time and space in the existing IAES can permit networks of extension services, became clearly visible in the lives of people whose work currently required them to

go and in touch with a wide range of extension agents to get benefit from the existing services. The mobile telephone facilitated Krishi Katha can make a huge explosion in person-to-person messaging, both through voice calls and interim technologies like text-based Short Messaging Service (SMS). While at the present it is impossible to say what types of new behaviours could emerge, yet it can be argued that such technologies can reshape the existing extension service at the fundamental level of F2F interaction. The major impact of Krishi Katha stems from its capabilities to function both in real and asynchronous time. The net effect will be maximization of capacity utilization of the extension agents and reach to a larger audience to foster agricultural innovation and productivity in India.

3.11. Conclusion

Digitally facilitated knowledge architecture the DEK design of the DEAL places special emphasis on voluntary participation. DEAL (Kisan blog and Kishi katha in particular) as a socio-technical system facilitates the bottom up approach for knowledge sharing to the people from different organizations and backgrounds. A network of conversions exhibit inherent circularities and self amplifying feedback loops. The closure of the network results in a shared system of beliefs, values and possibly praxis, a context of meaning, which is continually sustained by ongoing conversation. The DEAL experience in expanding the Indian agriculture extension services knowledge network and the self catalyzing characteristics exhibited by several applications like the Kisan blog and Krishi Katha inspire new research interests regarding the role of participative digital communication as enabler for innovation in large complex socio - technical systems.

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